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| EXAMINER | |
|---|---|
| LANDAU, MATTHEW C | |
| **ART UNIT** | **PAPER NUMBER** |
| 2815 | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/995,031 | AMOS ET AL. | |
| | Examiner | Art Unit | |
| | Matthew C. Landau | 2815 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *27 August 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,2,7-11 and 14-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,7-11 and 14-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/2/07*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 7-11, and 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suguro (US Pat. 6,476,545) in view of Talwar et al. (US Pat. 6,300,208, hereinafter Talwar) and Huang et al. (US Pat. 6, 248,673, hereinafter Huang).

Regarding claims 1, 2, 10, 11, and 17, Figure 2C of Suguro discloses a MOSFET comprising: a semi-conducting substrate 11 having source and drain regions (not shown but inherent); a gate dielectric layer 13 made of $HfO_2$ (col. 6, lines 37-40); and a gate 14/15 formed of a metal comprising Mo or W (col. 6, lines 44-48) on top of said gate dielectric. Suguro does not explicitly disclose the thickness of the gate dielectric is less than 50 angstroms. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Suguro by using a thickness less than 50 angstroms, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). The ordinary artisan would have been motivated to modify Suguro in the manner described above for the purpose of increasing the integration density (by forming smaller devices).

A further difference between Suguro and the claimed invention is the gate electrode comprises Re. Figure 2H of Talwar discloses a MOSFET device comprising a gate electrode 9

made of Re, Mo, or W (col. 5, lines 46-50). Therefore, Talwar implicitly discloses that Re, Mo, and W can be equivalently used for the same purpose. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Suguro by using Re as the gate electrode for the purpose of selecting an equivalent material that is known in the art to be used for the same purpose (see MPEP 2144.06). Note that the limitation "wherein said Re is derived from a $Re_2(CO)_{10}$ precursor" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966.

A further difference between Suguro and the claimed invention is the gate has an interface trapped charge density of about 3E 10 $cm^{-2}$ $eV^{-1}$ to about 4E 10 $cm^{-2}$ $eV^{-1}$. Huang discloses annealing a MOSFET in a hydrogen environment at a temperature of about 350 ° C at a pressure of about 700 torr (col. 8, lines 21-46 of Huang). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Suguro by using the hydrogen anneal process of Huang for the purpose of stabilizing interface states and trapped charges (col. 8, lines 54-57 of Huang). After performing the hydrogen anneal taught by Huang, it is inherent that the trapped charge density will be about 3E 10 $cm^{-2}$ $eV^{-1}$ to about 4E 10 $cm^{-2}$ $eV^{-1}$.

Regarding claims 7-9 and 14-16, Suguro does not specifically disclose the material of the semiconductor substrate. However, it would have been obvious to the ordinary artisan at the

time the invention was made to further modify the invention of Suguro by using an n or p-type silicon substrate, such as that taught by Talwar (col. 4, lines 39-41 and col. 5, lines 6-10 of Talwar) for the purpose of selecting a well-known, inexpensive semiconductor material.

***Response to Arguments***

Applicant's arguments filed July 24, 2007 have been fully considered but they are not persuasive.

Applicant argues that "Suguro discloses a structure in which a diffusion barrier is present between the metal gate and the gate dielectric" and therefore does not disclose a gate *vertically abutting* said gate dielectric as presently claimed. However, as indicated in the above rejection, it can be considered that layers 14 and 15 (as shown in Figure 3 of Suguro) together form the gate. Both layers 14 and 15 are formed of metal. The claim merely requires a gate formed of a metal *comprising* Re. Since layer 15 is made of Re (after the combination set forth in the above rejection), the gate (14/15) comprises Re and vertically abuts the gate dielectric 13. As stated above, the limitation "wherein said Re is derived from a $Re_2(CO)_{10}$ precursor" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966. The burden is on Applicant to prove that the process limitation necessarily results in a different product.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is 571-272-1731. The examiner can normally be reached on 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew C. Landau
Primary Examiner
Art Unit 2815
11/9/07